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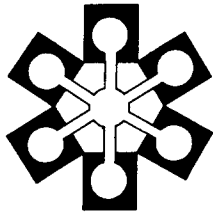
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# CogSci News

**Cognitive Science Program, Lehigh University, Bethlehem, PA.**

Volume 7, Number 1  
Spring 1994

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## Editorial Policy

This newsletter is published twice each year, in spring and fall issues, by the Cognitive Science Program at Lehigh University. Its purpose is to inform faculty and students about the interdisciplinary and growing field of cognitive science and to report the activities of Lehigh's Program.

The newsletter is distributed free of charge in the United States and Canada to academic programs and individuals interested in cognitive science. Anyone who would like to be added to the mailing list should simply notify the Production Editor.

The Editorial Staff welcomes readers' comments and *solicits materials* dealing with cognitive science. We are especially pleased to consider course syllabi, short essays, brief descriptions of scholarship and research in progress, extended abstracts of doctoral dissertations, book reviews, and original art work (e.g., cartoons, line-drawings, computer-generated images).

Address all submissions, comments, and subscription requests to: John B. Gatewood, CogSci News, Lehigh University, 681 Taylor St., Bethlehem, PA 18015-3169. Send electronic mail to [jbg1@Lehigh.edu](mailto:jbg1@Lehigh.edu) or to [gdb0@Lehigh.edu](mailto:gdb0@Lehigh.edu).

## Cognitive Science at Georgia Tech

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The cognitive science program at Georgia Tech is first and foremost a community of researchers. It also provides an interdisciplinary certificate program for graduate students. Cognitive science faculty and graduate students are primarily based in the School of Psychology, the College of Computing, and the School of Industrial and Systems Engineering. Researchers from other schools in the College of Engineering, the College of Architecture, and the School of Literature, Communication, and Culture (LCC) are also members of the team.

Research in cognitive science at Georgia Tech is driven both by theoretical questions and practical concerns. This diversity in "basic to applied" comes in part from our history and role in the Georgia Tech strategic plan. Tech has traditional strengths in engineering and a focus on practical application of knowledge. The cognitive science program is part of a university-wide thrust to broaden Tech's scope in basic as well as engineering sciences and in phenomena dominated by the complexities of human cognition and interaction as well as the purely physical.

Georgia Tech provides an interactive environment conducive to interdisciplinary research including cognitive science. Researchers focusing on how to make complex control systems easy to learn interact with researchers doing laboratory experiments on concept learning. Researchers interested in rhetoric and writing interact with AI researchers studying story understanding. Researchers teaching architectural design work with those developing AI models of memory. Researchers

study human cognition and use human cognition as inspiration for building both intelligent computer programs and computer programs that can interact intelligently with people.

An important interdisciplinary theme throughout cognitive science at Georgia Tech is practical cognition. Theoretical issues are brought to real problems of consequence for the workplace or classroom. The complexities of practical situations generate challenges for theory. Interdisciplinary ties also link cognitive science faculty with several other groups on campus, including the Graphics, Visualization, and Usability Center (GVU), the Engineering Psychology Program, the Computer Integrated Manufacturing Systems Program (CIMS), and the Manufacturing Research Center (MARC). We benefit from interaction with faculty at Emory, Georgia State, and University of Georgia and with several industry liaisons in Atlanta.

Four themes pervade cognitive science research at Georgia Tech: learning, problem solving, design, and language & communication. Much of this work involves empirical investigation of what people do, reliance on computational modeling of both people and systems they interact with, and design of new tools. Here are examples of each kind of research activity:

Researchers in the cognitive science group study *learning* by analyzing components of concept or procedural learning in constrained laboratory experiments, by studying classroom learning of math and science, by computational modeling of learning strategies such as model-based

(continued on page 2)

## CogSci at GA Tech (cont.)

and case-based reasoning and of strategy selection, by designing effective control systems, by designing computational teaching aids, and by analyzing the historical record of scientific discovery.

Researchers study *problem solving* as a factor driving cognitive development, as it occurs in the classroom, and as a test bed for comparing the strengths of model-based and case-based reasoning.

Researches working on *design* build cognitive models of design, develop computer-based design aids, and explore the pedagogical issues in teaching design.

*Language and communication* researchers focus on the relations between language and other cognitive tasks such as the relations between syntax and meaning, how people learn a procedure from reading a text, models of constructing a story interpretation from a text, and the role of language in guiding learning about event categories or learning about problem sub-goals.

### The Certificate Program

Cognitive science activities at Tech began purely as a research agenda, bringing together faculty in several departments. A colloquia series was one of our

first collaborative endeavors and our first success in getting some institutional money, as well. Three years ago, we instituted a certificate program to help give both structure and recognition to educating our cognitive science students. In our program graduate students are admitted into one of the departmental disciplines. Students may elect to complete the certificate program, which functions like a high powered major.

The certificate requirements are designed for flexibility and tailored to students in Computing, Psychology, and Industrial Systems Engineering, so that completing the certificate does not add to the time to complete a degree. In addition to the training students receive for the Ph.D. in their home unit, students take core courses in cognitive science, disciplinary and methodology courses in disciplinary areas, and topical courses and seminars. The ongoing Cognitive Science Colloquium Series gives students the opportunity to interact with leading researchers in the field.

Students are admitted to the Ph.D. program of a home unit, typically the College of Computing, the School of Psychology, or the School of Industrial and System Engineering.

Students do not need to have a particular bachelor's degree for entrance to any of the core units, but extra course work to

fill in gaps in undergraduate training may be required. Our intention is to be flexible with students entering interdisciplinary programs. For more information about the program or about whom to contact for admission into the various units, contact the cognitive science education coordinator at [cogsci-info@cc.gatech.edu](mailto:cogsci-info@cc.gatech.edu) or, currently, Dorrit Billman at [dorrit.billman@psych.gatech.edu](mailto:dorrit.billman@psych.gatech.edu).

### Faculty

A summary of faculty, their academic units and research interests follows (where LCC=Literature, Communication, and Culture. Comp=Computing, Psy=Psychology, ISyE=Industrial Systems Engineering, Arch=architecture, and ME=Mechanical Engineering):

Ron Arkin, robotics and action-oriented perception; Comp  
Albert Badre, human-computer interaction; Comp  
Nelson Baker, intelligent tutoring for engineering; ME  
Chuck Bazerman, scientific communication; LCC  
Dorrit Billman, concepts, language, and learning; Psy  
Susan Bovair, learning and language; Psy  
Richard Catrambone, problem solving and analogy; Psy  
Terry Chandler, science education; Comp  
Eric Domeshek, case-based design; Comp  
Kurt Eiselt, language understanding; Comp  
Askok Goel, problem solving and learning; Comp  
T. Govindaraj, human-machine systems; ISyE  
Alex Kirlik, dynamic decision making; ISyE  
Janet Kolodner, case-based reasoning; Comp  
Christine Mitchell, complex dynamic systems; ISyE  
Nancy Nersessian, scientific discovery, visualization; LCC/Psy/Comp  
Ashwin Ram, learning; Comp  
Mimi Recker, learning; Comp  
Tony Simon, developmental mechanisms; Psy  
Linda Wills, creative design, programming expertise; Comp  
Craig Zimring, design tools and collaboration; Arch.



# When Does Consensus Indicate Cultural Knowledge?

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**Preface:** *Cultural consensus theory* is a joint venture between myself and William H. Batchelder and Susan C. Weller. We have published over a dozen papers, of which the two most important are Romney, Weller, and Batchelder (1986) and Batchelder and Romney (1988). I summarize some of this work at the end of the present paper, drawing mainly from Romney (1994) without further detailed citation. I begin, however, with some general remarks about consensus.

\* \* \* \* \*

The idea that consensus among subjects indicates knowledge has been around a long time. Researchers from a variety of fields knew that consensus indicates knowledge. Examples include the psychologist Spearman (1904), the linguist Sapir (1938), and the sociologist Kaufman (1946). After appropriate precautions to guard against bias, collusion, data collection artifacts, etc., we can probably safely interpret all consensus among subjects as indicating some kind of knowledge.

I think that it is useful to distinguish two broad classes of knowledge. The first arises from the inherent nature of the world and the evolutionary processes. Spiders, for example, know how to spin webs, capture prey, etc. Within a given species there would be enormous consensus about the pattern of the web, the mode of capturing prey, etc. I call this kind of knowledge "natural knowledge" to indicate that it is unlearned and arises in interaction between the nature of the organism and the inherent nature of the world environment with which it is interacting.

The second kind of knowledge is mostly found in humans and arises from human inventions and is learned and handed down from one generation to the next and usually varies from one society to another. In culture consensus theory this kind of knowledge is designated as "cultural knowledge." Language provides the most useful and prototypical example of this meaning of culture. The line between

"natural knowledge" and "cultural knowledge," as between all arbitrarily constructed categories, is not absolute and sometimes is difficult to distinguish.

Two necessary, if not sufficient, parts of the definition of culture are that it is shared among relevant participants and that it is learned as part of a social heritage. The word "relevant" alerts us to the idea that there may be small specialized subgroups, such as medical practitioners, that share esoteric knowledge not known by the wider cultural group. Careful reflection reveals that the notion of culture involves sharing of ideas, concepts, behaviors, etc., by more than one person.

Let us examine an example of cultural sharing discussed by Sapir (1938) more than a half-century ago, the order of the letters in the alphabet. Imagine that we are researchers from outer space and we want to determine if the order of the alphabet is part of the culture of English speaking college students in an area called the United States. Suppose that we interviewed two students from widely separated areas and observed the same order of 26 letters. What would we conclude? The first thing we would conclude is that the consensus among the students is not due to chance ( $p = 1/26!$ ).

In order to infer that the consensus among the students on the order of the alphabet is cultural we must rule out alternative explanations. These alternatives include: unintended artifacts of the interviewing procedure, prior collusion among the students, answers derivable from the biological and neurological nature of the human species, answers derivable from the biological and neurological nature of animals in general, etc. Assume that we could rule out such explanations as artifacts, collusions, etc., how do we rule out some kind of inborn human universal? A minimum requirement for the confident inference of shared cultural knowledge would be to demonstrate that not all humans could perform the task. For example, one could repeat the task among monolingual Chinese college students who have

never seen the English alphabet. Assuming that they could not recover the order of the letters of the alphabet such an observation increases our confidence in inferring a culturally defined pattern.

To illustrate that not all consensus is cultural we provide a couple of examples. Consider, for example, a task in which we present 10 pictures, half containing trees somewhere in the picture and half not containing trees. Subjects are asked to identify which pictures contain trees. Herrnstein (1979) has performed such an experiment with pigeons and shows that they "can discriminate pictures of trees from pictures lacking trees after minimal training, [and] that the discrimination generalizes to new instances with little or no decrement" (1979:128). This is an example of "natural knowledge" and would require no learning (beyond the language to understand the questions posed) on the part of human subjects. The fact that this kind of consensus, and thus knowledge, goes beyond humans clearly proves that it cannot be considered cultural.

An example of "natural knowledge" among humans may be found in Boster and Johnson (1989) where they presented silhouette line drawings of fish. Presumably any college student, anywhere in the world, as well as a trained monkey, could sort the silhouettes in terms of similarity and get the same general results as found in the article. One would also expect the taxonomic distance to correlate significantly with the judged similarities, as it does. Boster (1987) presents another example of "natural knowledge" in his paper on judged similarities among bird specimens collected in South America. He shows high correlations among taxonomic distance and scientists, Aguaruna subjects, Huambisa subjects, and Kentucky college students. He reports that the finding demonstrates that "Cultural transmission is apparently not a prerequisite to shared understanding; here, independent observers agree as a result of common inferences from experience" (1987:914).

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# Concensus Theory (cont.)

I want to return to the example of the alphabet discussed above. It is important to note, and take to heart, the observation that whatever "reality" the order of the alphabet possesses, it resides in the consensus of the people involved. If all the users of the alphabet decided to change the order, they could. Of course it would require changing all the encyclopedias, dictionaries, and other printings that depend on the current order. This would be so painful that we cannot conceive of the idea of changing the order, but in theory it is possible. The bottom line is that the order of the alphabet is coded in the heads of all members of the culture so well that the result is virtually perfect consensus. In this case perfect knowledge revealed by perfect consensus. How do we reason about consensus when it is less than perfect? We now turn to an early attempt to answer that question and illustrate the fundamental idea that we measure knowledge by the amount of consensus that we observe.

Our example comes from Spearman's paper on "General Intelligence, Objectively Determined and Measured" (1904). This paper was written well before the development of modern test theory and Spearman was struggling with the problem of how to define and measure intelligence. Some authors, e.g., Harman (1960), ascribe the origin of factor analysis to this paper. Guilford (1954) believes that "No single event in the history of mental testing has proved to be of such momentous importance as Spearman's proposal of his famous two-factor theory in 1904" (1954:472). In his attempt to assemble a battery of tests to measure intelligence Spearman came to the following conclusion, "Let us, then, consider the extent of connection between two series of things implied by ... [the] fact of their presenting a numerical correlation with one another; such a correspondence, when beyond the range of mere chance coincidence, may be forthwith assumed to indicate and measure *something common* to both series in question" (1904:258).

The "something common to," with proper precautions, may be interpreted as knowledge. If we assume for a moment some hypothetical shared knowledge (truth) then Spearman's idea can be stated formally as the hypothesis that the correlation (amount of common knowledge) between any pair of individuals is a func-

tion of the correlation of each with the truth (see Snedecor 1946:145-147 for an explanation of correlation in terms of common elements). Equation 1 shows this in symbolic terms.

$$(1) \quad r_{ij} = r_{it} r_{jt}$$

When we consider a number of individuals we can make some rather powerful inferences from this simple idea. In Table 1 we illustrate this with just three individuals. The importance of this simple arrangement derives from the fact that we can observe correlations among pairs of individuals on any given knowledge task. From these observed correlations we can then deduce the  $r_{it}$ 's, i.e., how much each individual is correlated with the truth. We emphasize the observable values with shading.

Table 1.

---	$r_{12}$	$r_{13}$	$r_{1t}$
$r_{21}$	---	$r_{23}$	$r_{2t}$
$r_{31}$	$r_{32}$	---	$r_{3t}$
$r_{1t}$	$r_{2t}$	$r_{3t}$	

In consensus theory we use the same logic. Romney, Weller, and Batchelder (1986) formally derive a proof of the idea that the shared cultural competence of any pair of individuals is a function of the cultural competence of each of the individuals (1986:320). Table 2 displays the cultural competence idea in a form parallel to Spearman.

Table 2.

---	$D_1D_2$	$D_1D_3$	$D_1$
$D_2D_1$	---	$D_2D_3$	$D_2$
$D_3D_1$	$D_3D_2$	---	$D_3$
$D_1$	$D_2$	$D_3$	

There is an obvious and exact parallelism between Table 1 and Table 2. In Table 2 the pairwise competence products (the  $D$ 's) are observable from tests or experiments. The puzzle is to compute the individual  $D_i$ 's. We can illustrate how this works on some data presented by Spearman (1904:286) in the appendix to his article and reproduced below.

Spearman was attempting to measure differences in the subjects' intelligence. In

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SPEARMAN:

APPENDIX.

EXPERIMENTAL SERIES I.

*Village School, 24 Oldest Children.*

A. Original Data.

Sex.	Age.		Discriminative Threshold.			Intellectual Rank.	
	Years	Months	Pitch 1/2 v. d.	Light 1:2000	Weight 1:1000	Common Sense out of School. (A)	Cleverness in School. (B)
f	11	6	8	4	4	6	5
m	12	11	15	3	4	11	7
f	12	8	14	6	4	16	10
f	13	8	13	4	9	1	1
m	11	4	5	14	7	3	2
f	11	11	25	7	4	10	14
f	11	3	10	19	8	8	19
f	13	1	10	12	10	2	4
m	12	5	18	11	9	5	6
m	12	7	14	30	7	21	22
f	12	8	60	3	10	12	9
f	13	10	20	12	10	13	12
f	13	1	40	5	12	4	8
f	12	1	45	12	9	9	13
f	10	6	33	5	15	15	18
m	11	5	25	4	28	17	11
m	10	0	90	15	5	22	21
f	11	9	17	15	20	14	20
m	13	7	24	26	13	19	17
m	12	6	18	35	14	18	3
m	10	4	70	10	14	23	24
m	11	7	17	42	16	24	23
f	11	2	28	20	17	7	15
m	11	2	90	25	18	20	16

## Consensus Theory (cont.)

those days the ability to make discriminations in the various sensory modalities was thought to indicate intelligence and Spearman gives a long explanation for why he chose pitch, light, and weight as the particular discriminations to measure as indicators of intelligence. In order for him to show that the discrimination tasks were measuring "intelligence" he needed some measure of intelligence with which to compare the results of the discrimination test. He chose rankings by the two oldest students and the teacher. For purposes of illustrations here we will take just these three judgements and show how to estimate how much each student and the teacher "knows" about the "true" intelligence of the students in the class. The correlations among the three judges are given in Table 3.

Table 3.

---	.73	.59
.73	---	.61
.59	.61	---

In the case of just three subjects we can estimate competence by noting in Table 2 that  $D_1$  can be arrived at as follows:

$$(2) \quad D_1 = \sqrt{D_1^2} = \sqrt{\frac{D_1 D_2 \times D_1 D_3}{D_2 D_3}}$$

By applying this logic we arrive at estimates for the three judges as follows: first student has competence,  $D_1 = .84$ , second student has  $D_2 = .87$ , and teacher has  $D_3 = .70$ . More subjects would require more methodological apparatus. Cultural consensus theory is a formalization, extension, and derivation from axioms of these ideas and provides such methodological apparatus.

I want to turn now to a quick review of some samples and applications of the theory. The formal theory is presented in simplified form in Romney, Weller, and Batchelder (1986) while the full mathematical proofs are provided in Batchelder and Romney (1988). I should mention that all the mathematical elegance of the theory is a result of Batchelder's contribution.

The central idea in the original theory is the use of the pattern of agree-

ment or consensus among informants to make inferences about their differential knowledge of the shared information pool constituting culture. We assume that the correspondence between the answers of any two informants is a function of the extent to which each is correlated with the truth. From a set of three assumptions, we derived a set of procedures that enables one to estimate how much each informant knows of the question, as well as the probably correct answers to the questions. The assumption upon which our derivations of the formal model are based may be stated as follows:

*Assumption 1: Common Truth.* There is a fixed answer key applicable to all informants. This simply states that it is assumed that the informants all come from a common culture, that is, whatever the cultural reality is, it is the same for all informants in the sample.

*Assumption 2: Local Independence.* The informant-item response random variables satisfy conditional independence (conditional on the correct answer key).

*Assumption 3: Homogeneity of Items.* Each informant has a fixed "cultural competence" over all questions. This is a strong assumption that says that questions are all of the same difficulty level. In most situations a weaker assumption is warranted, namely, that the informants who tend to do better on one subset of questions will tend to do better on another subset of questions. This might be called the *monotonicity assumption* and is related to ensuring that the questions are drawn from a coherent domain. (Romney, Batchelder, and Weller 1987:165.)

This is not the place to write down a number of complicated mathematical formulas and to exclaim about the beauty of their interrelationships. But it is important to note the fact that consensus theory is formally derived from three axioms and that this is a considerable achievement. It means that we can now measure the cultural knowledge of informants with a degree of accuracy comparable to that obtained with traditional test theory even though test theory depends upon knowledge of the correct answers while consensus theory does not. One of the highlights

of the mathematical derivations was the discovery that the general model "is structurally isomorphic to the two class latent structure model if the roles of respondents and items are interchanged" (Batchelder and Romney 1988:75). In practice the latent class model was limited to samples of six subjects or less.

We derived least squares methods for the analysis of samples of any size. In addition we were able to estimate the number of subjects necessary to reach a specified level of confidence in the classification of a question as correct or incorrect. There are also explicit criteria for whether or not a given set of data satisfies the assumptions of the model. The application of the model makes possible a far deeper understanding of individual differences in cultural knowledge than heretofore.

The validity of the theory is much enhanced by the fact that cultural competence has unanticipated associations with other social and psychological characteristics, as pointed out in an important contribution by D'Andrade (1987). The characteristics discussed by D'Andrade are:

(1) *Reliability.* Cultural competence is related to test-retest reliability. For example, Boster (1985) found among the Aguaruna Jivaro that the informants with high cultural competence on a manioc plant naming task were much more likely to be reliable when asked to name these same plants on a retest than informants with lower cultural competence.

(2) *Consistency.* Cultural competence is related to internal consistency in a paired-comparison task. Weller (1984) found that in Mexican villagers' judgements of disease concepts in a paired-comparison task, higher competence informants made fewer intransitive responses (i.e., displayed greater internal consistency) than lower competence informants. Brewer, Romney, and Batchelder (1992) replicated this finding in two different domains with U. S. informants.

(3) *Normality.* High competence individuals are more likely to have had normal experiences with respect to the task. For example, Weller, Romney, and Orr (1986) found that high school students with high competence about the truth or falsity of 135 statements about parental sanctions for rule breaking were less likely to have been physically abused by their parents than low competence students. In other words, students who know the rules best are less likely to be physically abused.

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## Consensus Theory (cont.)

(4) *Education, intelligence, and experience.* D'Andrade discussed some data from a 125-word list with standard free association instructions from Moran et al. (1964). If one indexes cultural competence by *commonality* as presented in the article then the people with high competence have higher IQs ( $r = .42$ ), are somewhat better educated ( $r = .29$ ), and are more reliable ( $r = .58$ ).

The theory has been subjected to extensive testing through simulation (Maher 1987, Weller 1987) and Monte Carlo methods. It has been applied to a number of situations such as folk medical beliefs (Garro 1986, 1988; Ruebush, Weller and Klein 1992; Weller, Pachter, Trotter and Baer 1993), judgment of personality traits in a college sorority (Iannucci 1991), semiotic characterizations of alphabetic systems (Jameson 1989, Jameson and Romney 1990), occupational prestige (Romney 1989), causes of death (Romney, Batchelder, and Weller 1987), illness beliefs of deaf senior citizens (Steinhaus-Donham 1987), hot-cold concepts of illness (Weller 1983, 1984a, 1984b), child abuse (Weller, Romney, and Orr 1986), graffiti writers' evaluations of strategies to control illegal graffiti (Brewer 1992), and national consciousness in Japan (Yoshino 1989).

The original *American Anthropologist* article (Romney, Weller, and Batchelder 1986) provides an example of how consensus theory can shed new light on data collected for other purposes before the theory was developed. We reanalyzed the original data on contagion and hot-cold remedies reported earlier. The early studies only provided evidence to say that the hot-cold concept was not used in classifying the diseases because it did not relate to the similarity structure. Consensus theory provided evidence to demonstrate clearly that informants shared cultural competence about contagion with the average informant "knowing" about 82 percent of the information about which diseases were contagious. In contrast, consensus theory indicated that there was no evidence for shared knowledge about the hot-cold concept. Cultural consensus theory enables us to make this much stronger statement about the data. It reinforces the previous analysis by Weller and broadens the implications.

A recent study that illustrates the utility of cultural consensus theory in comparative research examined beliefs about the

disease *empacho* (Weller, Pachter, Trotter and Baer 1993). The authors had each done previous work on *empacho* in widely dispersed areas and in this study collaborated using a single method that allowed comparisons not only across sites but with previously published results. This paper should become a classic and deserves careful study. The sites studied were a rural town in Northeastern Guatemala; the urban town of Guadalajara, Mexico, with interviews with both urban and rural mestizos; Hidalgo County in South Texas among Mexican-Americans; and a Latino population of Puerto Rican informants in Hartford, Connecticut. Consensus theory showed some small variations among sites but overall found very large consistency in results across the sites that "suggest a common origin for the concept of *empacho*" (Weller et al. 1993:122). "A comparative study based upon a standard protocol is one of the most powerful methodological tools there is...[and] consistency in results across four diverse settings leads to the inference that a similar consistency in beliefs about *empacho* might be found in the encompassed region" (Weller et al. 1993:123).

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If you would like to make such a contribution (\$5, \$10, \$15), please make your check payable to "Cognitive Science Program" and mail it to Mark H. Bickhard, Cognitive Science Program Director, Lehigh University, 17 Memorial Drive East, Bethlehem, PA 18015.

**"A metaphor is like a simile."**

— Steve Wright

## Events (cont.)

given situation. Likewise, such organisms are equipped with the capability to adapt within current as well as new situations with little or no *a priori* knowledge or instruction and still manage to avoid the frame problem. Based on his recent review of a book about the frame problem (Ford & Hayes, 1991) for the journal *Artificial Intelligence* (in press), the speaker described the problem and explained how it is a symptom of the information-theoretic, electromechanical world view that has, by and large, propelled cognitive science for the past four decades. In particular, this posture involves the atomistic, temporal, and causal means by which the cognitive scientist views the organism and its relationship with the environment. As an alternative, the speaker discussed

a recent, less popular, yet emerging trend in cognitive science, commonly referred to as "situated action." As part of its world view, which differs greatly from traditional cognitive science, situated action focuses on interactions between the organism and environment. It is these interactions, comprising an indivisible, acausal, and atemporal whole between organism and environment, that are the prime movers for any subsequent "representations." More importantly, and contentiously, they appear to be free of the frame problem. Current notions of human and machine attention, perception, and cognition will be set against this backdrop in an attempt to illustrate how these two different world views—electromechanical on one hand, activity-based on the other—give rise to radically different notions of the nature of intelligence.



# Lehigh Events

17 February 1994

"Comparison and Choice:  
Domain-Specific and Domain-General  
Processing in Similarity and  
Decision-Making"  
Arthur Markman  
Department of Psychology  
Columbia University

Recent research has been concerned with what makes two things similar. This research suggests that similarity is most concerned with the commonalities shared by a pair of items and the differences that are related to those commonalities. Similarity is less concerned with differences that are unrelated to the commonalities. For example, when comparing a car and a motorcycle, the fact that both have wheels and cars have more wheels than motorcycles is more important than the fact that cars have jacks in them and motorcycles do not. Because similarity is important across a wide range of domains, it may be useful for many cognitive processes that require comparisons. For example, in trying to decide whether to buy a car or a motorcycle, commonalities and the differences related to them should also be more important than the differences unrelated to commonalities. This claim was examined through studies of decision-making behavior in which subjects choose between sets of consumer products. In addition to the role of a domain-general process like comparison, the speaker also discussed the role of more domain-specific processes (e.g., specific to choices between cars and motorcycles) in decision-making behavior.

24 March 1994

"The Development of the Child's  
Theory of Mind"  
Kim Cassidy  
Department of Psychology  
Bryn Mawr College

When trying to explain and predict a person's behavior, we typically refer to concepts such as the person's beliefs, hopes, and desires. Philosophers and psychologists have termed a person's use of mental states to predict and explain

another's behavior as a naive psychology or a theory of mind. While most researchers agree that preschool children as well as adults exhibit a theory of mind, it has been argued that young children have a fundamentally different understanding of the minds of others than do adults. In contrast to this view, the speaker presented data suggesting that the young child's theory of mind is, at core, very close to the adult's theory. The speaker argued that children, like adults, show consistency between the beliefs and knowledge that they attribute to others. The mental states that children attribute are consistent with one another. Data were presented that support the idea that children can reason about the mental states of others in a similar fashion to adults, under the right conditions. Finally, the speaker tried to reconcile her general conclusion (that children's theory of mind closely parallels that of the adults) with young children's poor performance on typical measures of theory of mind. Specifically it appears that, when predicting another's behavior, young children employ certain heuristics that, although generally reliable, cause the children to make mistakes under some circumstances.

14 April 1994

Annual Cognitive Science Keynote  
Lecture—"Grammatical Disorders in  
Aphasia: Theory and Treatment"  
Myrna Schwartz  
Neuropsychology Research Laboratory  
Moss Rehabilitation Hospital,  
Philadelphia

Linguists draw a principled distinction between the mental operations that underlie use of individual words—lexical operations—and those that underlie use of meaningful sentences—grammatical operations. In individuals who suffer language loss (aphasia) due to stroke or other neurological damage, lexical and grammatical operations may be selectively affected. The "agrammatic" aphasic communicates primarily through strings of isolated words and sentence fragments, frequently failing to convey critical information about who's doing what to whom. This talk reviewed current theories of grammatical deficits in aphasia and how

these are manifested in production and comprehension. Particular emphasis was placed on the mapping deficit theory, which locates the impairment in the mapping, or translation, between deep and surface grammatical representations. Recent attempts at treating grammatical disorders that follow from this theory were also reviewed.

15 April 1994

"Speech Errors in Fluent Aphasia"  
Myrna Schwartz  
Neuropsychology Research Laboratory  
Moss Rehabilitation Hospital

In collaboration with Gary Dell, Schwartz and her colleagues are exploring parallels between disordered speech production in aphasics and normals. An initial study compared the rate and distribution of some theoretically interesting error types in a jargon aphasic and a normal error corpus. A study in progress looks at error patterns in a confrontation naming task. The relevance of aphasic errors for theories of word and sentence production in normals were discussed.

29 April 1994

"The Frame Problem and World Views  
in Cognitive Science"  
Jozseph Toth  
Department of Computer Science  
University of Pittsburgh

The frame problem is a knowledge representation issue in cognitive science highlighting the inability to represent completely aspects of the world that do not change as the result of an action in the world (McCarthy & Hayes, 1967). Proposed solutions have required "omniscience," or complete knowledge of the surrounding world, in order to maintain consistently everything in the knowledge representation. Most argue that the frame problem is unsolvable, much like the inability to divide any number by zero or infinity. In contrast, human beings, and even other organisms, from dragonfly to whale, are quite adept at avoiding frame problems in that they intuitively know what to attend to and what to ignore in a

(continued on page 7)

# Meetings of Interest

## IEEE World Congress on Computational Intelligence

Held in Orlando, Florida, June 26-July 2, 1994, this year's congress consists of three IEEE International Conferences: the Third IEEE International Conference on Fuzzy Systems, the IEEE International Conference on Neural Networks, and the IEEE Conference on Evolutionary Computation, as well as a five day symposium entitled "Computational Intelligence: Imitating Life." For more information, call: (714)-752-8205

or send electronic mail to:

74710.2266@compuserve.com

## Association for Computational Linguistics

The 32nd Annual Meeting of the Association for Computational Linguistics will be held from June 27-July 1, 1994, at New Mexico State University in Las Cruces. For other information on the conference and on the ACL more generally, contact:

Judith Klavans (ACL)

Columbia University

Computer Science

New York, NY 10027, USA,

or call/fax:

(914)-478-1802

or send electronic mail to:

acl@cs.columbia.edu

## Computation and Neural Systems Meeting

The third annual inter-disciplinary conference, held July 21-26, 1994, in Monterey, California, addresses the broad range of research approaches and issues involved in the general field of computational neuroscience. The meeting will equally emphasize experimental, model-based, and more abstract theoretical approaches to understanding neurobiological computation. Details available electronically: "ftp 131.215.137.69" then "cd cns94" then "ls" to view a directory of meeting information. Register by "telnet mordor.bbb.caltech.edu" and login as "cns94" and answer all questions.

## Conference on Uncertainty in Artificial Intelligence

The 10th Annual Conference on Uncertainty in Artificial Intelligence will be

held July 29-31, 1994, preceding AAAI-94. For more information, contact:

David Heckerman

One Microsoft Way

Bldg 9S.1024

Redmond, WA 98052-6399

or call:

(206)-936-2662

or send electronic mail to:

heckerma@microsoft.com

## AAAI-94 and IAAI-94

The American Association for Artificial Intelligence will hold its 12th national conference at Seattle, Washington, July 31-August 4, 1994. The 6th Annual Conference on Innovative Applications of Artificial Intelligence will occur concurrently. For more information, write:

AAAI

445 Burgess Drive

Menlo Park, CA. 94025, USA

or call:

(415)-328-3123

or send electronic mail to:

ncal@aaai.org

## Simulation of Adaptive Behavior

The theme of the 3rd International Conference on Simulation of Adaptive Behavior "From Animals to Animats." The object of the conference is to bring together researchers in ethology, psychology, ecology, cybernetics, artificial intelligence, robotics, and related fields so as to further our understanding of the behaviors and underlying mechanisms that allow animals and, potentially, robots to adapt and survive in uncertain environments. The conference will be held in Brighton, UK, August 8-12, 1994. For general enquiries contact:

SAB94 Administration

COGS University of Sussex Falmer

Brighton, BN1 9QH UK

or call:

+44 (0)273 678448

or send electronic mail to:

sab94@cogs.susx.ac.uk

The SAB94 archive can be accessed via anonymous ftp from:

ftp.cogs.susx.ac.uk

## Cognitive Science Conference

Georgia Tech will be hosting the 1994 Conference of the Cognitive Science Society, August 13-15. The conference was moved to this later than usual date to accommodate a cognitive science workshop offered by SUNY Buffalo this summer.

Currently confirmed speakers include David Woods, Walter Schneider, and Lila Gleitman. Topical symposia include cognitive engineering, representation change, educational technology, visual reasoning, case-based learning, and collaborative knowledge. The symposia and plenary speakers are sometimes the most exciting part of a conference, particularly as means for seasoned researchers to get exposure to areas outside their own and for students just becoming familiar with the research in cognitive science. If your training is in computational approaches to language, for example, a plenary speaker on children's language acquisition may be a valuable tour of the psychological perspective on some of the same issues. A symposium on a topic such as education may flesh out how cognitive science can usefully synthesize different perspectives. They are trying out a new presentation format. Some posters will be organized into small groups and discussants will comment on the presented work at the end of the poster session.

For inquiries about the conference, send electronic mail to:

cogsci94@cc.gatech.edu

Information will also be maintained in the MOSAIC database at Georgia Tech.

## RIAO '94

The theme of this year's conference, October 11-13, 1994, at Rockefeller University, NYC, will be Intelligent multimedia information retrieval systems and management. This conference, held every three years since 1985, allows researchers, product developers and companies to present and demonstrate the latest evolutions in information retrieval. New trends in hardware organization, telecommunication networks, hyperlinking, heterogeneous document creation, computational linguistics, and other fields modify the way that information retrieval can be

(continued on page 10)

## Meetings (cont.)

imagined. This conference is a forum for innovative responses to this field as well as to related problems in very large databases, public access to information, multimedia information retrieval, interface specifications, and others. Topics of interest to cognitive scientists include new paradigms for information retrieval, linguistic analysis of text for automatic indexing and abstracting, large knowledge bases including electronic dictionaries, thesauri, neuronal networks, conceptual graphs, case-based reasoning systems for text and genetic information bases, user understanding and modeling, and multimodal interfaces. For more information, call/fax:

(212) 714-1421

or send electronic mail to:  
id@nuri.inria.fr

### **Boston University Conference on Language Development**

The 19th annual conference will be held November 4-6, 1994. The focus this year will be "First and Second Language Acquisition." For more information, send electronic mail to:

info@louis-xiv.bu.edu

### **Neural Information Processing Systems**

The eighth meeting, held November 28-December 3, 1994 in Denver, Colorado, will bring together neuroscientists, engineers, computer scientists, cognitive scientists, physicists, and mathematicians interested in all aspects of neural processing and computation. Two days of focused work-

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shops will follow at a nearby ski area (Dec 2-3). For more information, contact:

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